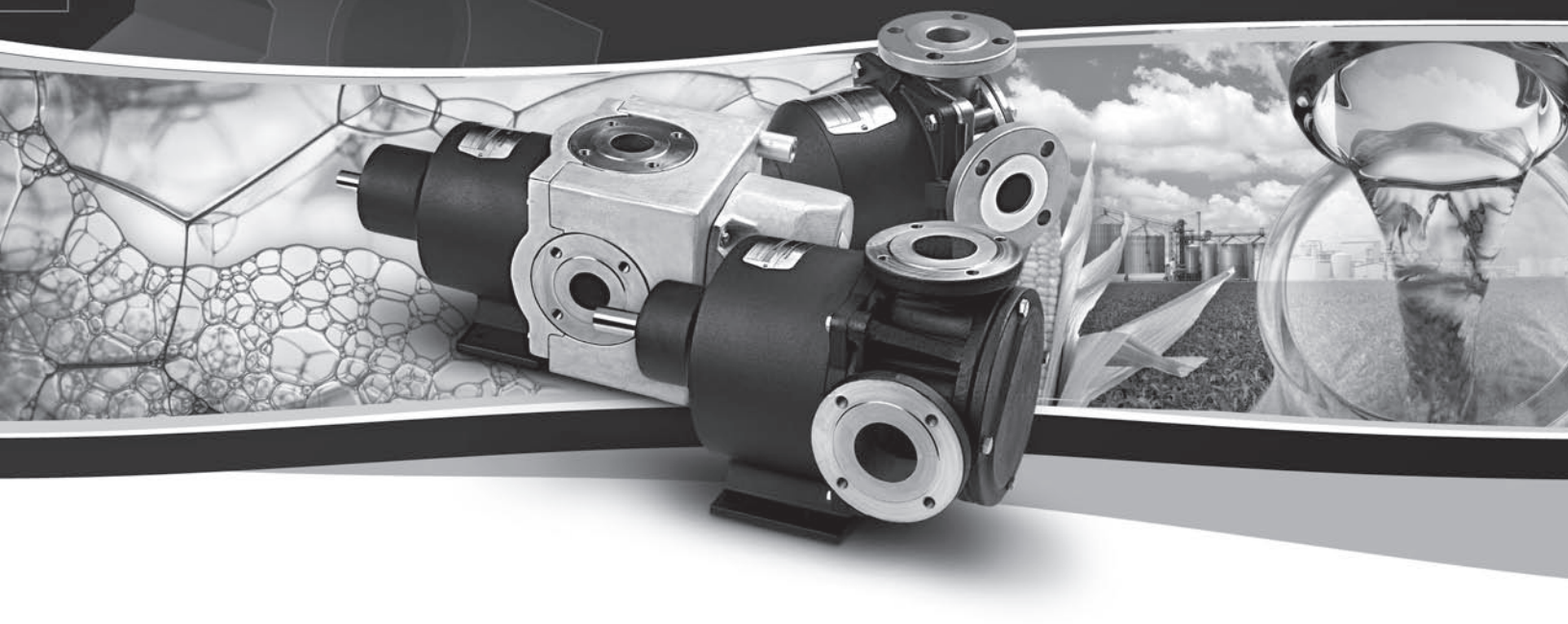
EnviroGear®

INTERNAL GEAR PUMPS

A DOVER COMPANY



SERVICE MANUAL

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CAUTION: In any positive-displacement pump system, a reliable pressure protection device must be used in the discharge piping to avoid a dangerous pressure increase, which could cause the pump or any component in the discharge piping to burst, which could cause serious injury. A pump-mounted integral relief valve is not intended to be used in this manner.

CAUTION: This pump contains powerful permanent magnets that can cause serious injury. Read the appropriate section of this service manual before doing any service work.

DANGER: *Magnetic Field.* Can disrupt medical implants such as pacemakers. Implant wearers should remain a minimum of 1ft (0.3m) away from pump and 3ft (1m) away from disassembled magnets.

Pinch Point. Inner and Outer magnets strongly attract each other which can crush and cut.

CAUTION: Magnets inside pump can damage electronic equipment or magnetic media.

CAUTION: This pump is designed to rotate only in the direction indicated. Do not run the pump in the opposite direction, for long periods because internal passageways that control axial thrust will not work correctly, causing premature wear and reduced pumping efficiency.

CAUTION: The inner magnets on the back of the rotor assembly are strongly attracted to the outer magnets in the outer drive assembly. During the separation process, there will be a strong force of up to 300 lbs (136 kg) trying to pull them back together, which can create a powerful pinch point.

To safely separate the rotor assembly from the outer drive assembly, follow the instructions below and use the following equipment:

- Crane, hoist or other suitable lifting device capable of generating at least 400 lbs (182 kg), and
- Sturdy workbench that has the following features:
  is positioned beneath the lifting device, and is firmly anchored to the floor, or if unanchored, the workbench must weigh at least 400 lbs (182 kg), and is strong enough to resist a lifting force of up to 400 lbs (182 kg). Pump Disassembly Tool F-00096 or F-00097.

CAUTION: Carbon-graphite bushings are very brittle, so they must be handled and assembled using great care.

- Always use an arbor during assembly to guide and align the bushings.
- When pressing bushings, use a light lubricant.
- When pressing bushings, always use a smooth, continuous motion – stopping with the bushing partially exposed can crack the bushing.
- After assembly, always inspect the bushings closely for cracks.

CAUTION: You must press the bearing by its inner ring to avoid damaging it.

CAUTION: Failure to have each magnet segment in opposite polarity with adjacent magnets will cause a significant reduction of coupling torque.

CAUTION: Maximum temperature limits are base upon mechanical stress only. Certain chemicals will significantly reduce maximum safe operating temperatures. Consult Chemical Resistance Guide for chemical compatibility and temperature limits.

CAUTION: Prevention of static sparking – if static sparking occurs, fire of explosion could result. Pump, valves, and containers must be grounded to a proper grounding point when handling flammable fluids and whenever discharge of static electricity is a hazard.

CAUTION: Always wear safety glasses when operating pump.

Always read the most current version of this manual before performing any work with this pump. The most current version is freely available on the web at www.envirogearpump.com

EnviroGear® pumps are specifically configured for your unique application conditions. Those application conditions and the details of the pump configuration were documented during the ordering process. Keep that information available in a safe place, as it may be needed when troubleshooting pump problems or when ordering spare parts or repairs.

EnviroGear pumps are covered by one or more of the following patents: U.S. Patent Nos 7549205, 7137793, 7183683, Australian Patent No AU2005233534B2, Korean Patent No 10-2006-7023162, Mexican Patent No PA/a/2006/011436, Russian Patent No 2006138540/06(041952) and other patents pending.

Models Available

Ductile Iron Model	Std Port Size	Capacity (cu. inches per revolution)	Max Pump Speed (rpm)	Nomimal Flowrate (usgpm at max speed)	Pump Weight	
					(lb)	(kg)
S1-24-DI	2" NPT	24.3	780	75	152	69
S1-32-DI	2" NPT	32.6	780	100	152	69
S1-55-DI	3" ANSI 150# RF	54.9	640	135	307	139
S1-69-DI	3" ANSI 150# RF	68.7	640	170	307	139
S1-82-DI	3" ANSI 150# RF	82.4	640	200	307	139

Max Differential Pressure = 200 psi (13.8 bar)

Figure 2.1 – ductile iron models

Carbon Steel Model	Std Port Size	Capacity (cu. inches per revolution)	Max Pump Speed (rpm)	Nomimal Flowrate (usgpm at max speed)	Pump Weight	
					(lb)	(kg)
S1-2-CS	1 1/2" NPT	2.19	1800	15	53	24
S1-4-CS	1 1/2" NPT	4.34	1800	30	53	24
S1-24-CS	2" NPT	24.3	780	75	152	69
S1-32-CS	2" NPT	32.6	780	100	152	69
S1-55-CS	3" ANSI 150# RF	54.9	640	135	307	139
S1-69-CS	3" ANSI 150# RF	68.7	640	170	307	139
S1-82-CS	3" ANSI 150# RF	82.4	640	200	307	139

Max Differential Pressure = 200 psi (13.8 bar)

Figure 2.2 – carbon steel models

Stainless Steel Model	Std Port Size	Capacity (cu. inches per revolution)	Max Pump Speed (rpm)	Nomimal Flowrate (usgpm at max speed)	Pump Weight	
					(lb)	(kg)
S1-2-SS	1 1/2" ANSI 150# RF	2.19	1200	10	53	24
S1-4-SS	1 1/2" ANSI 150# RF	4.34	1200	20	53	24
S1-24-SS	2" ANSI 150# RF	24.3	640	55	152	69
S1-32-SS	2" ANSI 150# RF	32.6	640	80	152	69
S1-55-SS	3" ANSI 150# RF	54.9	520	110	307	139
S1-69-SS	3" ANSI 150# RF	68.7	520	140	307	139
S1-82-SS	3" ANSI 150# RF	82.4	520	160	307	139

Max Differential Pressure = 150 psi (10.3 bar)

Figure 2.3 – stainless steel models

Notes:

1. Recommended pump speeds may be lower than the maximum shown in Figures 2.1, 2.2 and 2.3, based on specific application conditions.
2. Pump weights shown in Figures 2.1 and 2.2 are based on standard pumps with a relief valve. This weight will vary, depending on specific pump options.
3. EnviroGear will supply more specific flowrate values for your application conditions upon request.

Temperature Ratings

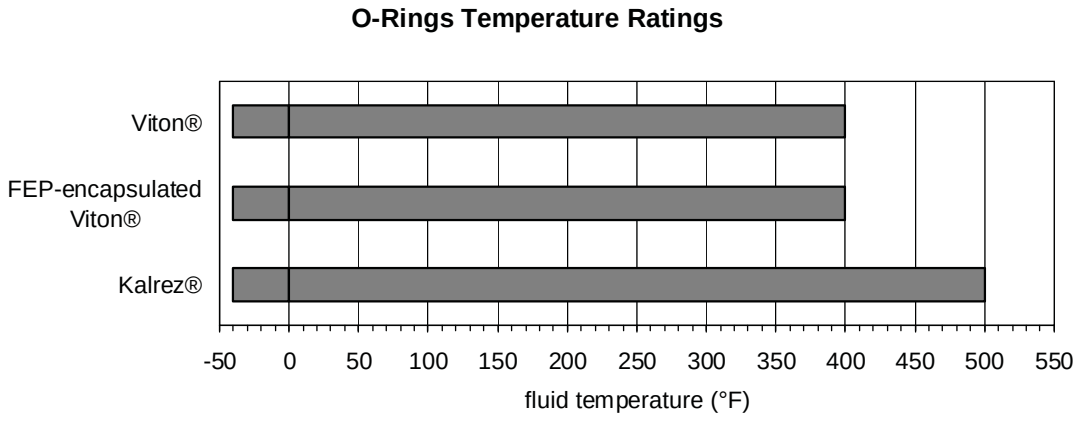


Figure 2.4 – o-rings temperature ratings

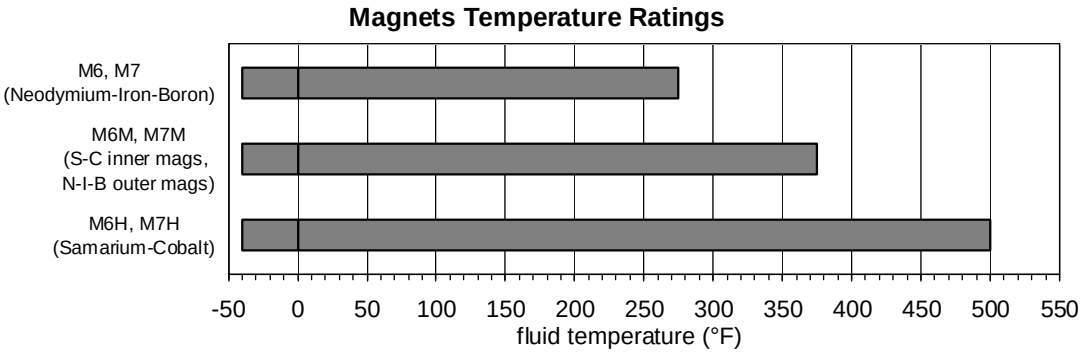

Magnets Temperature Ratings
M6, M7 (Neodymium-Iron-Boron)
M6M, M7M (S-C inner mags, N-I-B outer mags)
M6H, M7H (Samarium-Cobalt)
-50 0 50 100 150 200 250 300 350 400 450 500 550
fluid temperature (°F)

Figure 2.5 – magnets temperature ratings

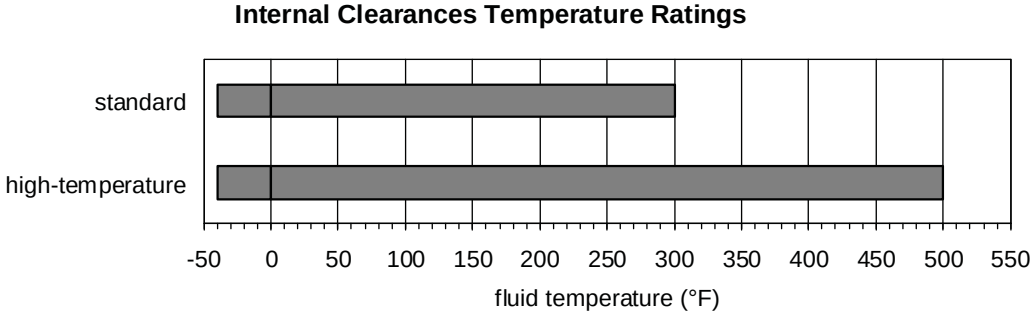

Internal Clearances Temperature Ratings
standard
high-temperature
-50 0 50 100 150 200 250 300 350 400 450 500 550
fluid temperature (°F)

Figure 2.6 – internal clearances temperature ratings

Magnetic Coupling Strengths

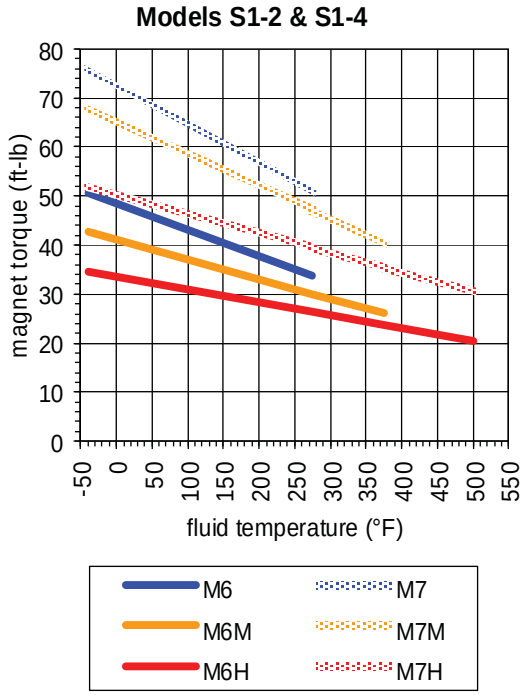


Figure 2.7
models S1-2 & S1-4
magnetic coupling strength

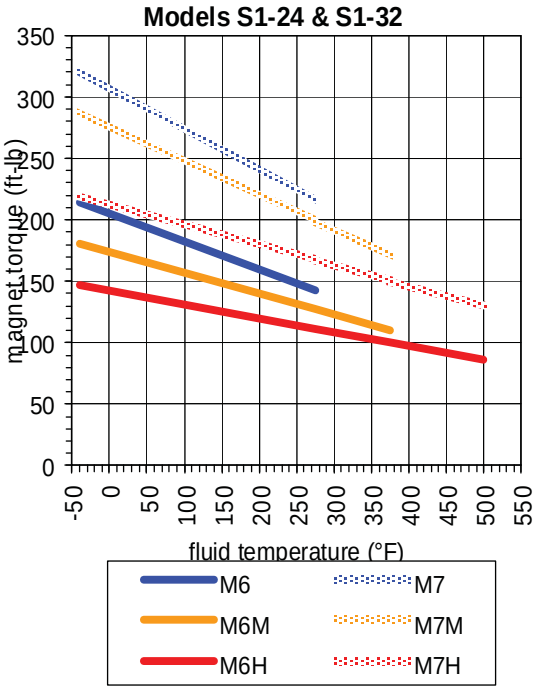


Figure 2.8
models S1-24 & S1-32
magnetic coupling strength

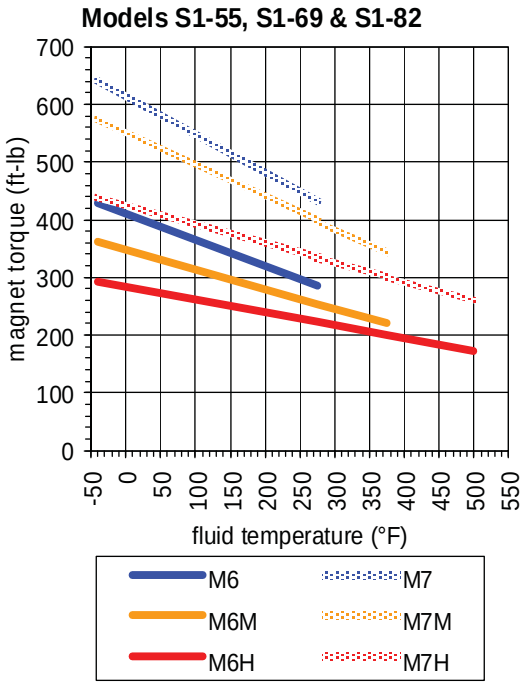


Figure 2.9
models S1-55, S1-69 & S1-82
magnetic coupling strength

Relief Valve Performance

Optional integral relief valves provide pump protection from over-pressure conditions. While not intended for continuous use, internal relief valves protect the pump from closed discharge valves or other intermittent over-pressurization in the system. The EnviroGear design is spring loaded and contains only three parts. It addresses the problem of over-pressurization by "cracking" (poppet lifts off the seat) at the nominal pressure relief setting, allowing pumped fluid to recirculate internally from the discharge side back to the suction side.

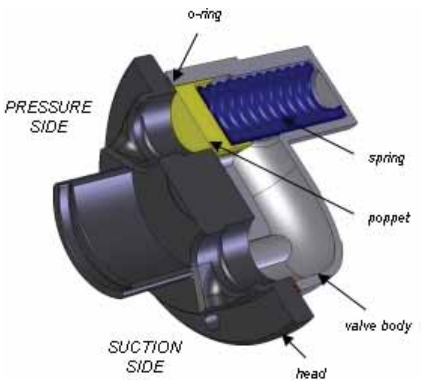


Figure 2.10 – relief valve

To maintain the integrity of the relief valve setting, the EnviroGear relief valve is not adjustable by means of an external jack screw. Rather, seven relief valve settings are fixed at the factory and adjusted by changing the poppet and spring combinations.

Available relief valve settings (crack pressure):

- 50 psi (3.4 bar)
- 75 psi (5.2 bar)
- 100 psi (6.9 bar)
- 125 psi (8.6 bar)
- 150 psi (10.3 bar)
- 175 psi (12.1 bar)
- 200 psi (13.8 bar)

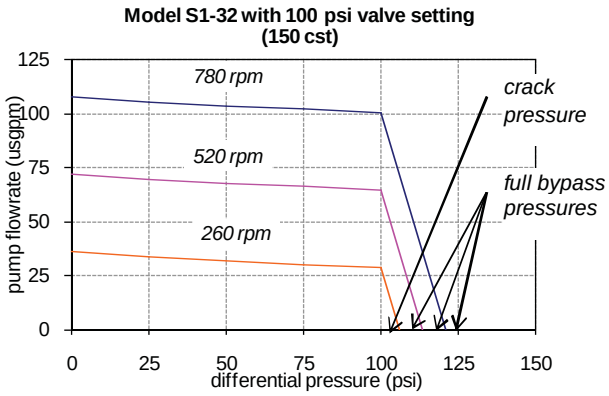


Figure 2.11 – relief valve performance

To properly size the integral relief valve, it is important to understand the differences between ***crack pressure*** and ***full bypass pressure*.**

- ***Crack pressure*** is the pressure at which the poppet just begins to lift of the seat. This pressure is not affected by variations in fluid viscosity or pump speed. The pump will provide full flowrate at all pressures below the cracking pressure (see Figure 2.10).

- ***Full bypass pressure*** is the pressure that occurs when 100% of the pump's flowrate is bypassing internally through the valve, and no flow is exiting the pump (see Figure 2.10). This pressure is higher than crack pressure, and varies depending on fluid viscosity and pump speed.

Internal Cooling Circuit

This pump has an internal cooling circuit that circulates some of the pumped fluid through the magnet chamber. The circuit starts at the discharge port and ends at the suction port. This circuit has three functions:

1. cool the inner magnets,
2. keep fluid in the magnet area from becoming stagnant,
3. lubricate and cool the rotor and idler bushings.

Note: Consult factory at low differential pressures to ensure proper cooling path circulation.

There are special plugs in the casing and head that must be in the correct position to complete the circuit:

1. The casing needs to be vented on the DISCHARGE side. In some cases, this is done with an orifice plug that has a hole in it, positioned in the casing hole behind the DISCHARGE port. In other cases, this is done by leaving the casing hole behind the DISCHARGE port open.
2. The casing block-off plug is solid (no hole). It belongs in the casing hole behind the SUCTION port.
3. The head block-off plug is solid (no hole). It is only used in pumps that have no relief valve, and it belongs in the head hole on the DISCHARGE side.

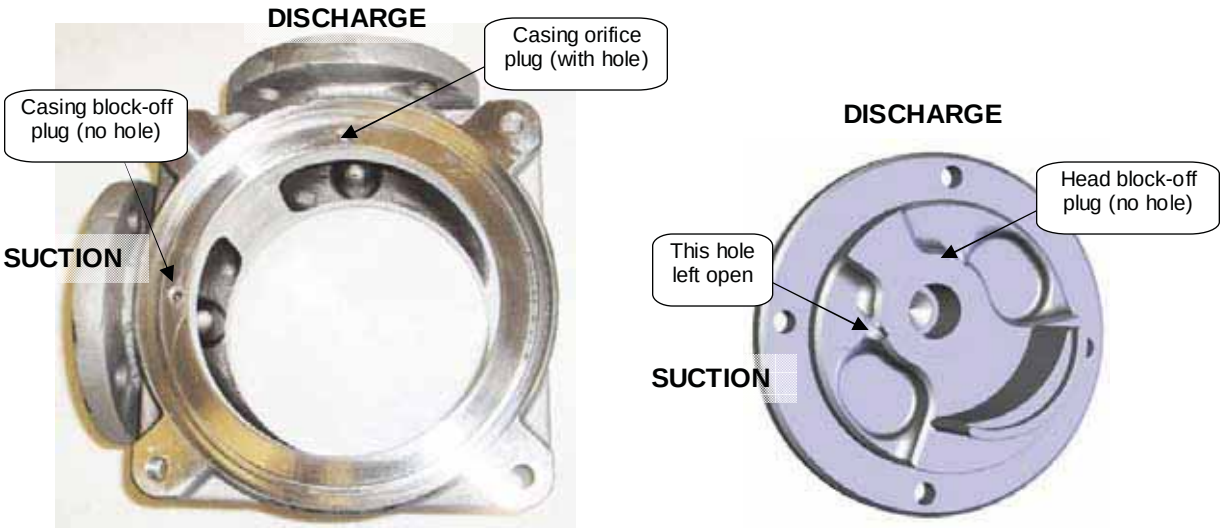


Figure 2.12 – special cooling circuit plugs in correct positions

Pump Location

It is always best to minimize suction line losses, so the best location for any pump is as close as practical to the liquid supply source. Also, it is best to locate the pump below the liquid supply, if practical, to maximize inlet pressure to the pump.

A proper location should leave enough room around the pump to allow for inspection or repair of the pump without removing it from the foundation.

Pump Foundation

With any pump, a rigid foundation is essential for optimal reliability and durability. Always mount the pump on a foundation that is rigid enough to keep the pump from moving during operation or in the event of any stress or impact that may occur during the life of the pump. Please contact EnviroGear for more information on premium EnviroBase base plates.

Pressure Relief

This is a positive-displacement pump. As such, for each shaft revolution, it will move a specific volume of fluid from the suction side to the discharge side. If the discharge line is severely restricted or blocked, a dangerous increase in pressure and drive torque will occur rapidly between the discharge port and the restriction, which will lead to one or more of the following events:

- the pipe or other discharge line components bursts,
- the drive stalls,
- the pump's inner and outer magnets decouple,
- a pump component breaks.

A reliable pressure protection device must be used in the discharge piping with any positive-displacement pump. It should be located as close as possible to the discharge port of the pump. Several common devices are:

- external relief valve,
- rupture disc,
- pressure regulator,
- pressure switch that stops the pump driver.

Torque limiting devices cannot react precisely to discharge pressure, and therefore must not be used as the primary pressure protection device.

Rotation and Port Orientation

The pump is configured in one of the 8 possible orientations shown in Figure 3.1, and it has labels on it which indicate direction of rotation, suction port and discharge port.

Figure 3.1 – eight possible port orientations

To change the orientation, see Chapter 5.

Piping

Excessive pipe stress can cause reduced pump durability and reliability by affecting shaft alignment and/or distorting pump components. Isolate the pump from any pipe stress. Here are several suggestions that help isolate the pipe stress:

- Properly support all piping with suitable pipe hangars or supports, not with the pump.
- Install flexible lines near the pump.
- If the pumped liquid will be hot, be sure to calculate pipe expansion and provide provisions for it.

All discharge piping components must be designed to safely handle the maximum system pressure.

Make sure all the pipes and other components are clean before installation.

A reliable pressure protection device must be used in the discharge piping with this positive-displacement pump. See section *Pressure Relief* above for more details.

Pressure gauges are valuable tools for troubleshooting pump-related problems. Install gauges near both pump ports (some pumps have gauge ports for this purpose). Also install gauges on both sides of high-restriction components, such as filters, heat exchangers or flowmeters. Remember, it is much easier to include gauges when the piping is first installed than to add gauges later.

Suction Piping

The suction piping must be able to supply liquid to the pump at the desired flowrate with sufficient pressure at the pump to avoid cavitation. To ensure this, you should calculate the NPSHa (available) for the suction piping design and compare it to the NPSHr (required) value for the pump – the piping NPSHa must be greater than the pump NPSHr to avoid cavitation. Here are several suggestions that help maximize suction piping NPSHa:

- Locate the pump below the liquid supply.
- Keep the suction piping short.
- Use large diameter piping. The difference in pipe friction between small and large pipe sizes can be dramatic, especially for high viscosities.
- Avoid high restriction components, such as filters, heat exchangers or flowmeters. Try to install these components in the discharge piping instead.
- Be sure to consider the full range of operating conditions, especially the highest viscosity conditions. Changes in viscosity can have a dramatic effect on pipe friction.

If your suction piping requires a long run and a rise (pump is higher than the liquid level at the supply), it is best to keep most of the run at the lower level, and position the rise as close to the pump as possible. This allows gravity to fill most of the piping.

If your suction piping must detour around an obstacle, it is best to go around it instead of over it. This lowers the vacuum needed for priming.

If your suction has a lift and it can drain back to the supply between runs, consider using a foot valve or check valve. This will keep the suction line filled between runs and ease priming. But be sure the valve is large enough that it doesn't cause excessive restriction (lowers NPSHa).

Consider using a strainer to protect the pump from any contaminant particles that could be present in the liquid. Be sure the strainer is properly sized so it doesn't cause excessive restriction (lowers NPSHa).

Be sure the suction piping is air-tight. Air leakage into the suction line can cause low flow, noise (similar to cavitation) and priming problems.

Shaft Alignment

Accurate alignment of the pump shaft and driver shaft is essential for optimal reliability and durability. Misalignment causes vibrations that reduce the life of bearings in both the pump and driver, and the life of couplings. Final shaft alignment must be done AFTER the following events, since both of them can change the alignment:

- Mounting and grouting of the foundation.
- Assembly of the piping.

Use of precision alignment equipment (based on lasers or dial indicators) is strongly recommended. Checking the alignment using a straight-edge on the couplings is inaccurate and not recommended.

For pumps that will operate at elevated temperature, the alignment at room temperature will change as the pump warms. Be sure to measure or calculate this effect and adjust the alignment, so that it is accurate at operating temperature.

Pump Condition Monitoring

There are several pump conditions that can be monitored:

- Canister Temperature.
  Heat is generated in the canister when the pump is running because of moving magnetic fields that pass thru it. The pump has an internal cooling path that pulls heat away from the canister. If this cooing path is obstructed, the canister and magnet area could become very hot, which could damage the magnets and/or the canister o-ring.

  The canister temperature can be monitored with a temperature probe attached to an optional access port in the magnet housing, near the casing.

- Bearing Vibration:
  The pump shaft is supported by rolling-element bearings. The condition of the bearings can be monitored with a vibration sensor attached to the magnet housing, near the bearings (see Figure 3.3).

- Pumping Chamber Vibration:
  The pumping gears rotate within the casing and are supported by journal bushings. The condition of the gears and bushings can be monitored with a vibration sensor attached to the pump head (see Figure 3.4).

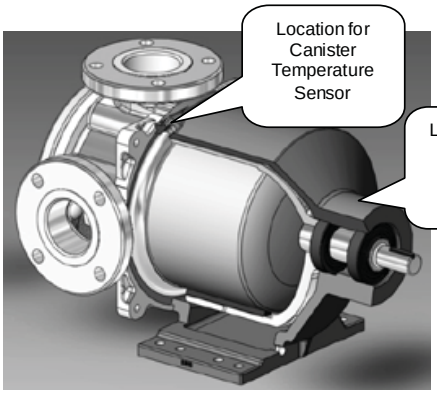


Figure 3.3 – optional sensor locations

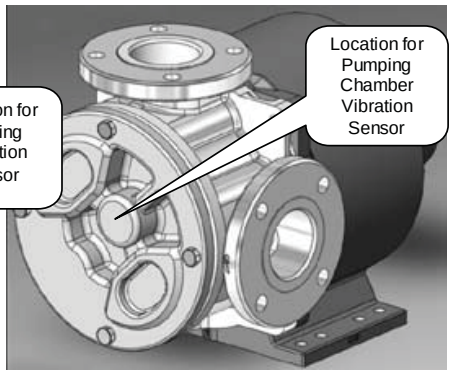


Figure 3.4 – optional sensor locations

Startup

Before starting the pump, follow this procedure:

1. Thoroughly clean the pump, pipes and other components. Note: In most cases, the pump is shipped clean of any contaminants, except for a thin layer of lubricant on the spindle and bushing surfaces. In some other cases, the pump will contain residual petroleum oil from the factory testing. EnviroGear can provide more details for your specific pump upon request.
2. Verify that the piping components are all tightened and in their final position.
3. Ensure the pressure relief device is installed and working correctly.
4. Verify that the shaft alignment is correct (see *Shaft Alignment* section above).
5. Verify that the pump freely turns by hand.
6. Verify that the driver rotates the pump shaft in the correct direction.
7. Open or close all valves in the suction piping to ensure that liquid will reach the pump.
8. Open or close all valves in the discharge piping to ensure that liquid will reach the intended location.
9. If the suction is not flooded, add a small volume of compatible liquid into the pump. This will improve the priming ability and lubricate the pump during a dry startup.
10. Verify that all guards and other safety equipment is installed and working correctly.
11. If the driver includes a gearbox, check the manual from the gearbox manufacturer to confirm that the lubricant is at the proper level, and for any additional startup procedures related to the gearbox.

Now the pump is ready to be started.

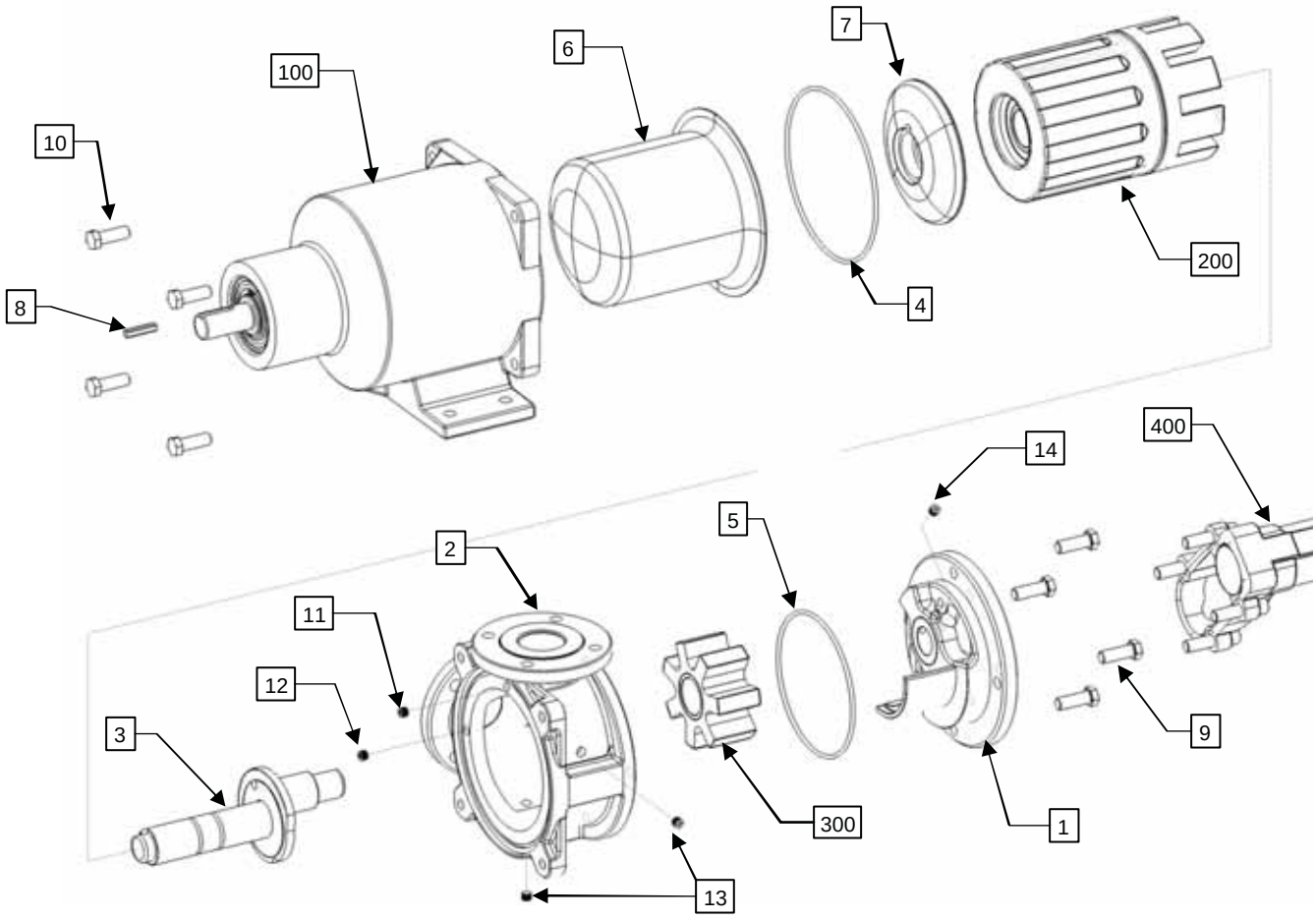
Once started, check the following:

- Is the pump moving liquid? If it doesn't within 60 seconds, stop the pump. See *Troubleshooting* section to help solve the problem.
- Are there any leaks in the piping? If so, stop the pump and fix them.
- Are there any unusual noises or vibrations? If so, stop the pump. See *Troubleshooting* section to help solve the problem.
- Is the pump performing as expected (proper flowrate and pressure)? If not, see *Troubleshooting* section to help solve the problem.

Repair Parts

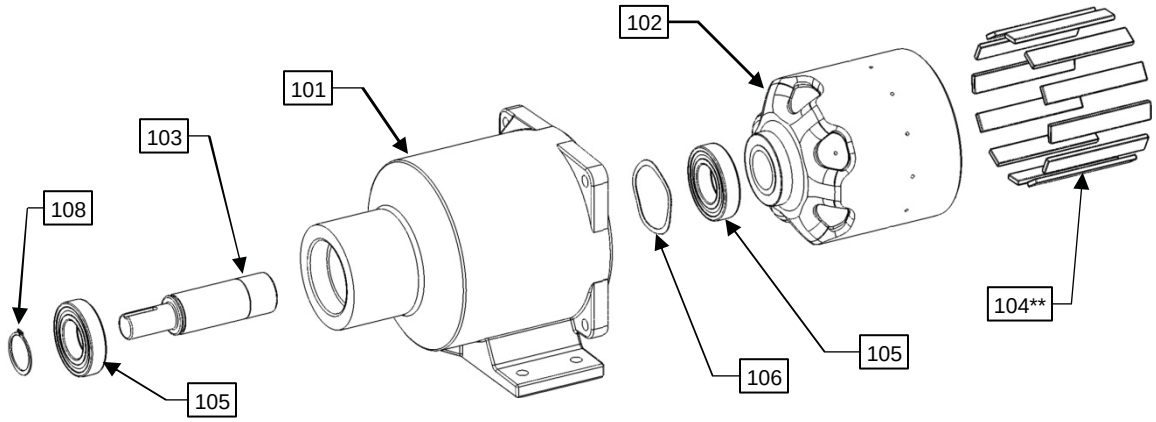
The parts used in this pump are designed and manufactured with exacting tolerances, material specifications and production techniques. Always use authentic repair parts supplied by EnviroGear® or its authorized selling partners. Use of any other parts may void the pump's warranty.

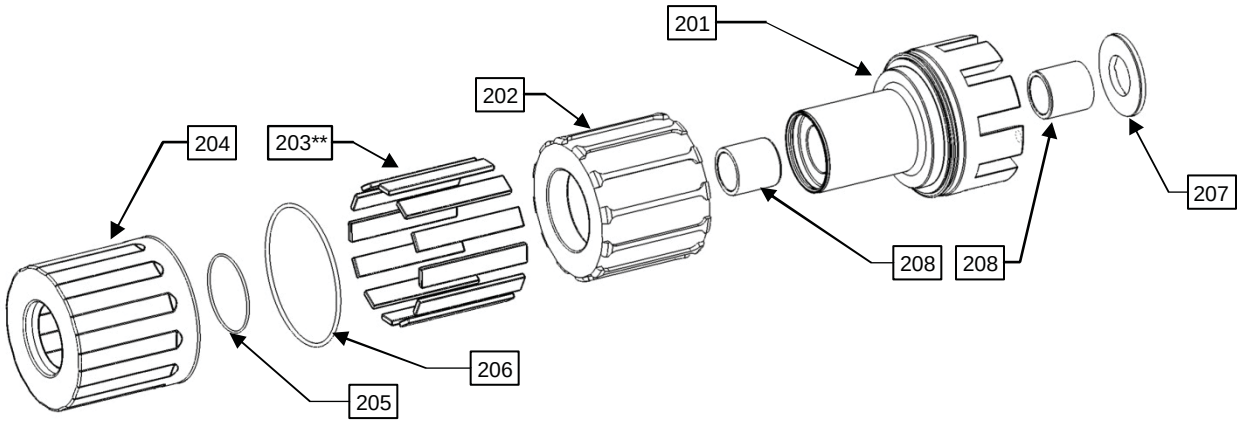
This EnviroGear® pump was specifically configured for your unique application conditions. conditions. EnviroGear® can supply a detailed bill of material that includes the part numbers for your specific pump configuration (identified by serial number). Use these part numbers when ordering repair parts.



Part ID #	Qty.	Part Name
1	1	Head
2	1	Casing
3	1	Spindle
4	1	O-Ring for Canister*
5	1	O-Ring for Head*
6	1	Canister
7	1	Support Plate
8	1	Key
9	4	Bolts for Head
10	4	Bolts for Outer Drive
11	1	Orifice Plug
12	1	Plug for Casing
13	2	Plugs for Vent/Drain
14	1	Plug for Head
100	1	Outer Drive Assembly
200	1	Rotor Assembly
300	1	Idler Assembly
400	1	Relief Valve Assembly

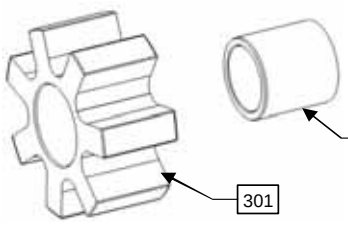
*Recommened spares.

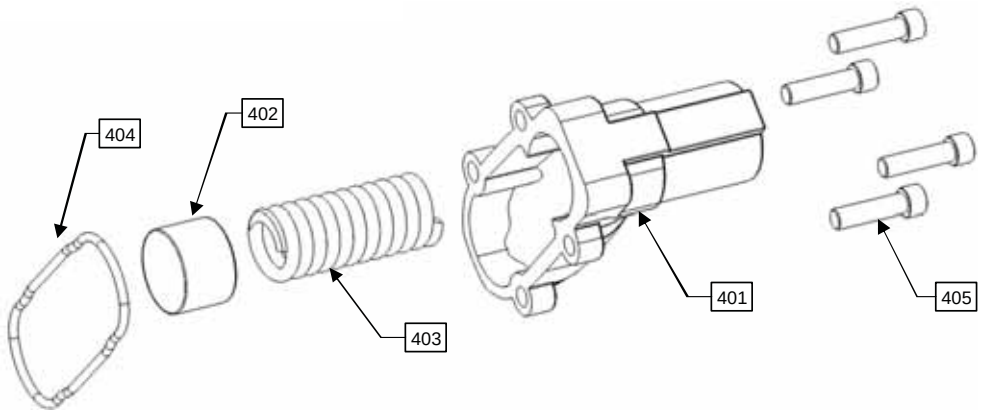


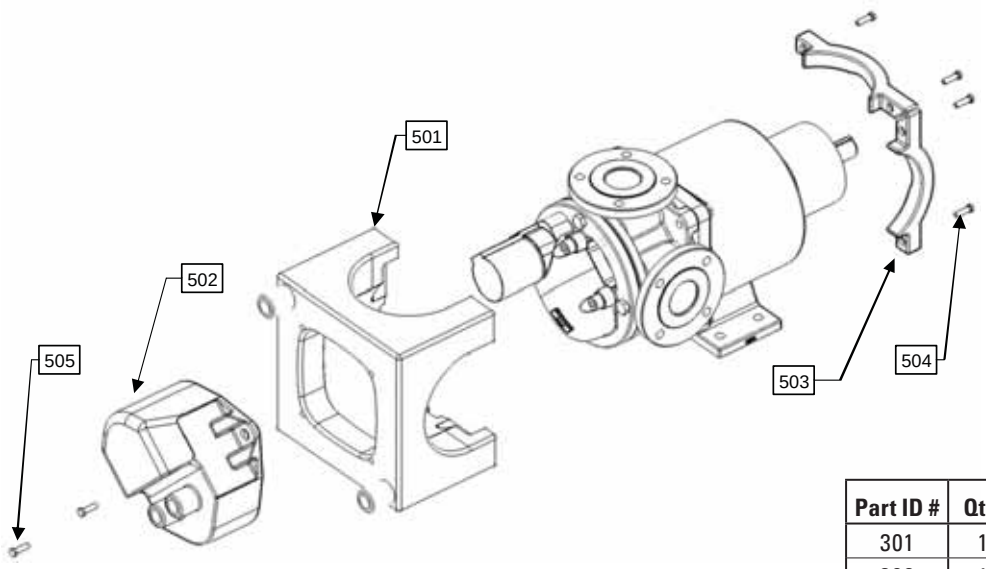


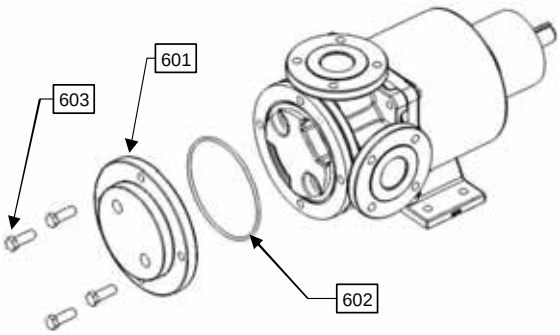
Part ID #	Qty.	Part Name
101	**1**	**Magnet Housing**
102	1	Outer Ring
103	1	Shaft
104	**	Magnet Segment
105	2	Ball Bearing
106	1	Wave Spring
107	-	Adhesive (not shown)
108	1	Retaining Ring
201	1	Rotor
202	1	Inner Ring
203	****	**Magnet Segment**
204	**1**	**Sleeve**
205	**1**	**O-Ring for back of sleeve**
206	1	O-Ring for front of sleeve
207*	1	Thrust Bushing
208*	2	Radial Rotor Bushing

*Recommened spares.
**Magnet quantities may vary depending on pump configuration.









Part ID #	Qty.	Part Name
301	1	Idler
302	1	Idler Busing*
401	1	Valve Body
402	1	Poppet
403	2	Spring
404	1	O-Ring for Valve*
405	4	Screws for Valve
501	1	Jacket for Casing
502	1	Jacket for Valve
503	1	Jacket Brackets
504	4	Screws
505	2	Screws
506	-	Thermal Cement (not shown)
601	1	Jacket for Head
602	1	O-Ring for Jacket*
603	4	Screw for Jacket

*Recommened spares.

How To Change Port Orientation Only (Shaft Rotation Unchanged)

This instruction applies for changes when the direction of shaft rotation will not change, such as changing from “RT to “TL”. Since the shaft rotation is unchanged, the discharge and suction positions relative to the casing and head will not change, and therefore the cooling circuit plugs will not be moved (see “*Internal Cooling Circuit*” in Chapter 2).

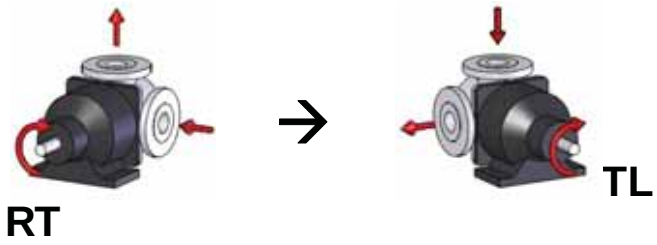


Figure 5.1 – port orientation change when shaft rotation does not change

1. If the pump is equipped with a relief valve, disassemble the relief valve per the instructions in Chapter 6, “*How To Disassemble Relief Valve*”. For Models S1-24, S1-32, S1-55, S1-69 or S1-82, the relief valve does not need to be disassembled – leave the relief valve attached to the head.

2. Disassemble pumping chamber per the instructions in Chapter 6, “*How To Disassemble Pumping Chamber”.*

3. Assemble pumping chamber in the new orientation per the instructions in Chapter 6, “*How To Assemble Pumping Chamber”.*

4. If the pump is equipped with a relief valve, assemble relief valve per the instructions in Chapter 6, “*How To Assemble Relief Valve*”.

How To Change Port Orientation And Shaft Rotation

This instruction applies for changes when the direction of shaft rotation will change, such as changing from “RT to “LT”. Since the shaft rotation will change, the discharge and suction positions relative to the casing and head will also change, and therefore the cooling circuit plugs must be moved (see “*Internal Cooling Circuit*” in Chapter 2).

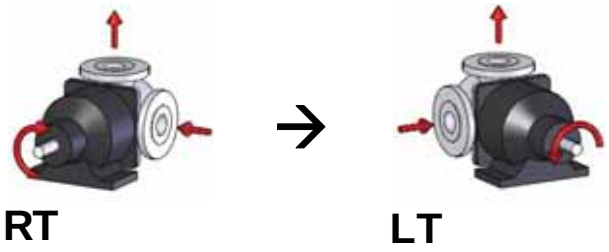


Figure 5.2 – port orientation change when shaft rotation changes

1. If the pump is equipped with a relief valve, disassemble the relief valve per the instructions in Chapter 6, “*How To Disassemble Relief Valve*”.

2. Disassemble pumping chamber per the instructions in Chapter 6, “*How To Disassemble Pumping Chamber*”.

3. Remove the casing orifice plug (11) (not used on all configs) and casing block-off plug. (12)

4. Install the casing orifice (if required) plug behind the DISCHARGE port.

5. Install the casing block-off plug behind the SUCTION port.

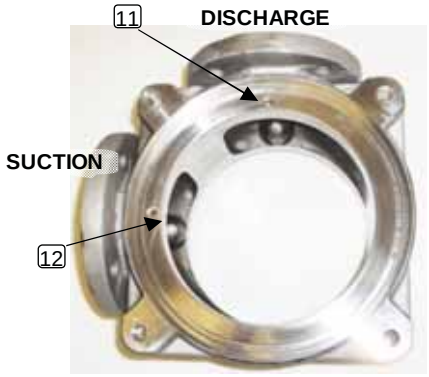


Figure 5.3 – Casing plugs

6. If the pump is not equipped with a relief valve, remove the head block-off plug (14) and move it to the DISCHARGE side.

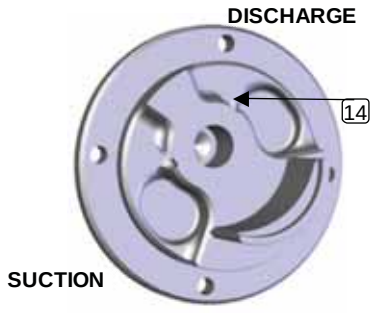


Figure 5.4 – head block-off plug

7. Assemble pumping chamber in the new orientation per the instructions in Chapter 6, "*How To Assemble Pumping Chamber".*

8. If the pump is equipped with a relief valve, assemble relief valve in the new orientation per the instructions in Chapter 6, "*How To Assemble Relief Valve*".

How To Change Relief Valve Pressure Setting

In order to maintain the integrity of the relief valve setting, the EviroGear relief valve is not externally adjustable. Instead, the setting is adjusted by changing the poppet and/or spring.

1. Obtain a new poppet and/or spring for the desired relief valve setting. (Consult factory for assistance)
2. Disassemble relief valve per the instructions in Chapter 6, "*How To Disassemble Relief Valve*".
3. Reassemble the relief valve using the new poppet and/or spring per the instructions in Chapter 6, "*How To Assemble Relief Valve*".

How To Change Relief Valve Pressure Setting

In order to maintain the integrity of the relief valve setting, the EviroGear relief valve is not externally adjustable. Instead, the setting is adjusted by changing the poppet and/or spring.

1. Obtain a new poppet and/or spring for the desired relief valve setting. (Consult factory for assistance)
2. Disassemble relief valve per the instructions in Chapter 6, "*How To Disassemble Relief Valve*".
3. Reassemble the relief valve using the new poppet and/or spring per the instructions in Chapter 6, "*How To Assemble Relief Valve*".

How To Disassemble Relief Valve

1. Remove the screws [405] that hold the valve body [401] to the head [1]. It is normal for the valve spring [403] to push the valve body away from the head during this step – the spring will be fully relaxed just before the screws are fully removed.

2. Remove the valve body, spring, poppet and o-ring [404].

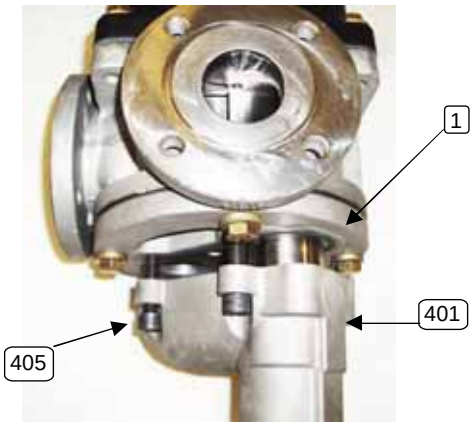


Figure 6.1 – valve body removal

Figure 6.2 – disassembled relief valve

How To Disassemble Pumping Chamber

1. Remove the screws [9] that hold the head [1] to the casing [2].
2. Remove the head.
   Note: when the head or spindle is removed, the pump will be difficult to turn by hand. This is normal.
3. Remove the head o-ring [5] from the head.

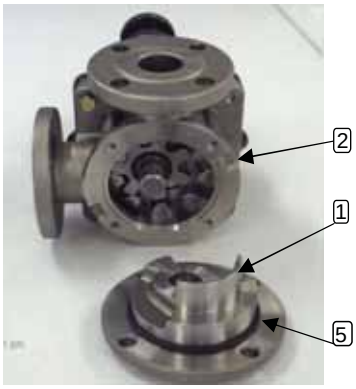


Figure 6.3 – head removed

4. Remove the idler assembly [300] by sliding it off the spindle [3].
5. Pull the spindle out of the rotor assembly [200].

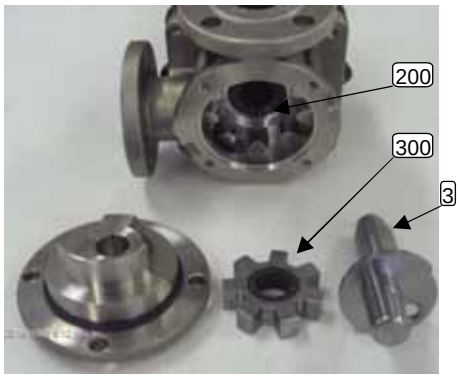


Figure 6.4 – idler and spindle removed

6. Remove the screws [10] that hold the outer drive assembly [100] to the casing.
7. Separate the casing and outer drive assembly.
8. Remove the canister o-ring [4] from its groove in the casing.

Figure 6.5 – casing removed

How To Remove Rotor Assembly From Outer Drive Assembly (Models S1-2 & S1-4)

Figure 6.6 – pump disassembly tool F-00097

1. Use Tool F-00097 to firmly grab the rotor assembly 200 in the bushing bore area.

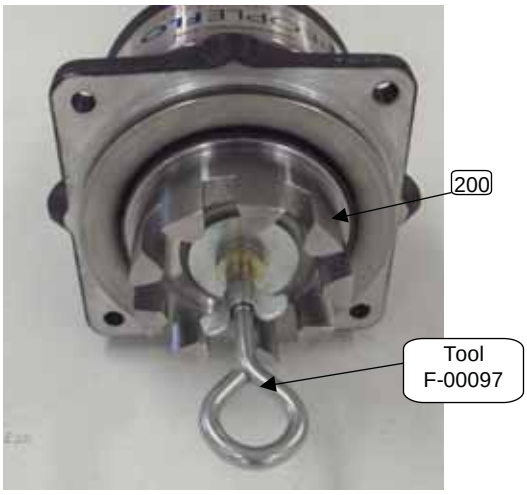
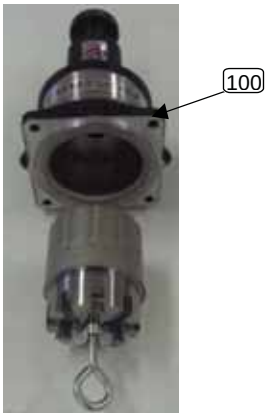


Figure 6.7 – tool inserted in rotor assembly

2. Pull the rotor assembly out of the outer drive assembly 100, using moderate force. It takes about 40 – 60 pounds of force (18 – 27 kg).

3. Remove the tool and set the rotor assembly aside, away from any magnetic material (e.g. steel, iron).



4. Remove the canister 6 (containing the support plate 7) from the outer drive assembly.

Figure 6.9 – canister removed

How To Remove Rotor Assembly From Outer Drive Assembly (Models S1-24, S1-32, S1-55, S1-69 & S1-82)

Figure 6.10 – pump disassembly tool F-00096

1. Attach the puller plate to the rotor assembly [200] using three of the pump's 1/2"-13 screws [9 or 10].

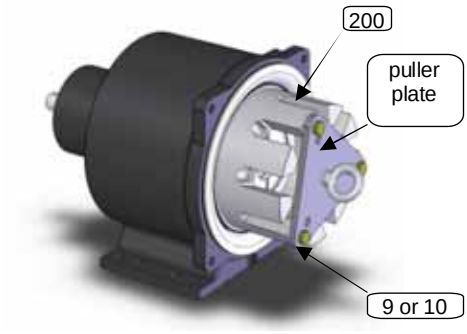


Figure 6.11 – puller plate attached

2. Loosely fit the two rods into opposite holes on the outer drive assembly [100].
3. Loosely position the two rod ends into the channel.
4. Twist the two rods to tighten the channel nuts, which locks the rods to the channel.

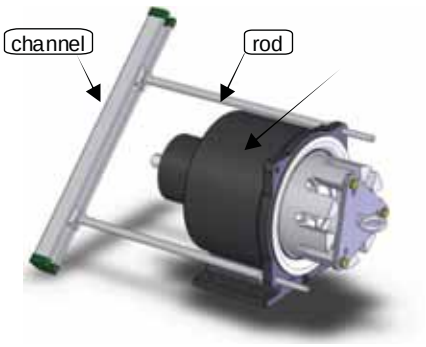


Figure 6.12 – rods and channel attached

5. Assemble the two wing nuts onto the two rods to hold them to the outer drive assembly.

6. Carefully lift the outer drive assembly (with the tool kit attached) and set it on a suitable workbench vertically, with the rotor teeth facing up.

7. Firmly affix the channel to the workbench surface, so that it can safely resist a lifting force of up to 400 lbs (182 kg).

Figure 6.13 – tool fully assembled

8. Slowly pull the rotor assembly up and away from the outer drive assembly, using a crane, hoist or other suitable lifting device.

9. Remove the puller plate and set the rotor assembly aside, away from any magnetic material (e.g. iron, steel).

Figure 6.14 – pull rotor assembly up

10. Remove the canister 6 (containing the support plate 7) from the outer drive assembly.

Figure 6.15 – remove canister

How To Replace Idler Bushings (carbon-graphite)

1. Remove the old bushing 302 by pressing it out of the idler 301 . It is not unusual for the bushing to crack or break apart during removal.

2. Inspect the idler bore for any damage. Any small scratches or nicks must be filed smooth before installing the new bushing.

3. Press the new idler bushing into the idler, leading with the tapered edge. The bushing is in its proper location when both ends of the bushing are flush or slightly recessed from the idler faces.

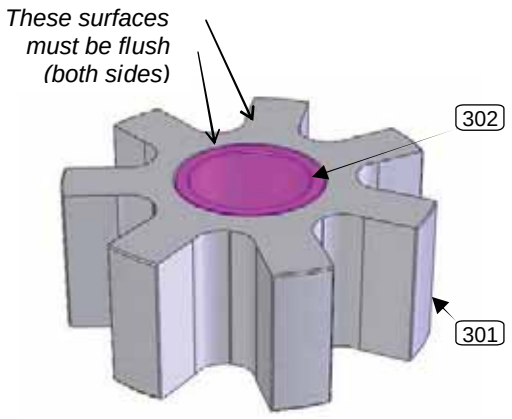


Figure 6.16 – idler assembly

How To Replace Rotor Bushings (carbon-graphite)

1. Remove the old bushings 207 208 by pressing them out of the rotor 201. It is not unusual for the bushings to crack or break apart during removal.

2. Inspect the rotor bore for any damage. Any small scratches or nicks must be filed smooth before installing the new bushings.

3. Press the front radial bushing 208 into the rotor, leading with the tapered edge. The bushing is in its proper location when the front face of the bushing is flush with the nearest rotor face.

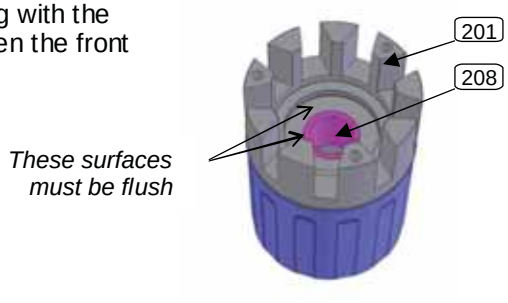


Figure 6.17 – front radial bushing installed

4. Press the thrust bushing 207 into the rotor, leading with the tapered edge, until it bottoms out.

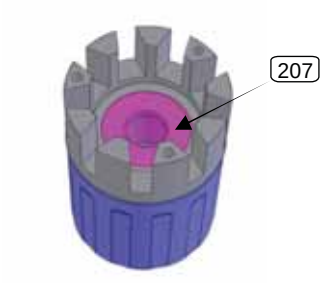


Figure 6.18 – thrust bushing installed

5. Press the rear radial bushing 208 into the rotor, leading with the tapered edge. The bushing is in its proper location when the rear face of the bushing is flush with the nearest rotor face.

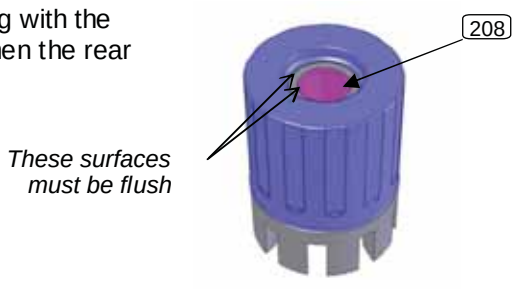


Figure 6.19 – rear radial bushing installed

How To Replace Idler Bushings (tungsten carbide or silicon carbide)

Due to the brittle nature of tungsten carbide and silicon carbide bushings, we recommend they be replaced in the EnviroGear factory.

How To Replace Rotor Bushings (tungsten carbide or silicon carbide)

Due to the brittle nature of tungsten carbide and silicon carbide bushings, we recommend they be replaced in the EnviroGear factory.

How To Replace Outer Ball Bearing

1. Position the outer drive assembly [100] on blocks in a suitable press with the shaft [103] facing upward.

2. Remove the snap ring [108] from its groove in the shaft.

3. Press the shaft downward until the outer bearing [105] disengages from the shaft.

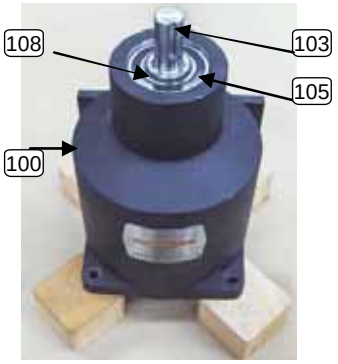


Figure 6.20 – outer drive assembly on blocks

4. Remove the outer ring assembly [102] (with shaft and inner bearing [105] attached), wave spring [106] and outer bearing.

5. Remove the inner bearing from the shaft with a suitable gear puller.

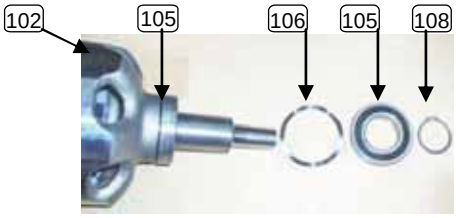


Figure 6.21 – bearing area components

6. Apply a light oil to the shaft, and press the new inner bearing onto the shaft. The new bearing inner race should be flush with the outer ring. Be careful to avoid disrupting the shaft position, relative to the outer ring.

7. Insert the wave spring into the inner bearing counterbore of the magnet housing.

8. Insert the outer ring/shaft/inner bearing assembly into the magnet housing.

9. Press the outer bearing onto the shaft until the distance from the end of the shaft to the face of the bearing meets the following specification:

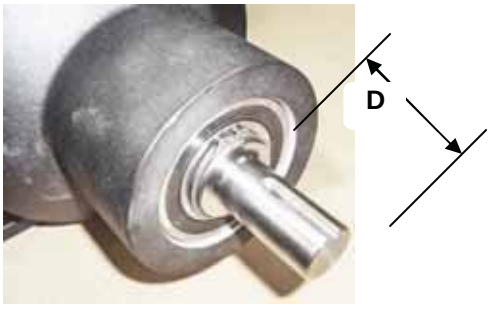


Figure 6.22 – outer bearing location

Model	distance “D”
S1-2, S1-4	1.898“ (48.21 mm)
S1-24, S1-32, S1-55, S1-69	2.536“ (64.41mm)
S1-82	3.911“ (99.34 mm)

10. Install the snap ring in its groove in the shaft.

How To Replace Inner Magnets

1. There are two methods to remove the sleeve from the rotor.

    a. Support the rotor assembly 200 on the front edge of the sleeve 204, with the teeth facing down. Leave at least 1 inch (25 mm) of clearance beneath the teeth. Then press the rotor down, separating it from the sleeve.

    b. Carefully cut the sleeve as shown in Figure 6.24. Be careful to avoid damaging the rotor in the area around the front o-ring. The sleeve will easily pull off the rotor after this cut is in place.

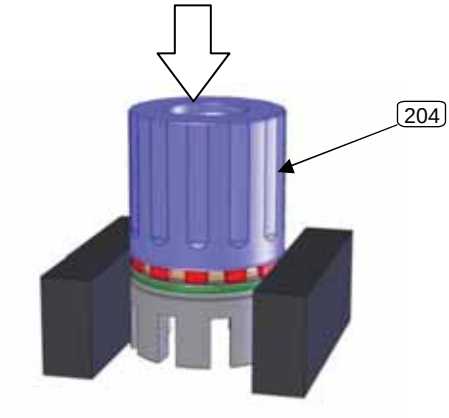


Figure 6.23 – method a

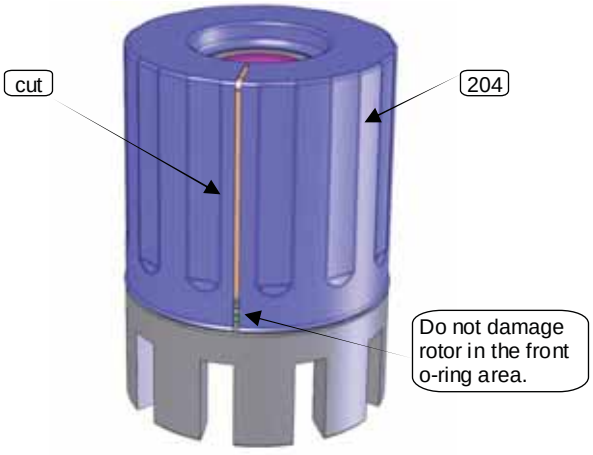


Figure 6.24 – method b

2. Remove the old magnet segments 203 from the inner ring 202.
    a. In most cases, the magnets are held in place only by their magnetic attraction to the inner ring.
    b. In a few other cases, they are held in place with epoxy. Contact EnviroGear for instructions for removing the epoxy.

3. Remove the front 206 and rear 205 sleeve o-rings from the grooves in the rotor.

4. Install new o-rings in the grooves in the rotor.

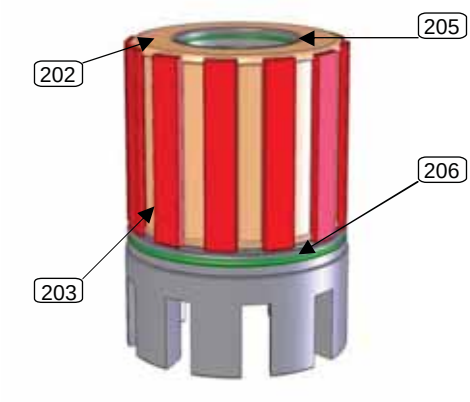


Figure 6.25 – sleeve removed

5. Slowly bring one end of a new magnet segment into contact with the end of one flat on the inner ring, such that only a short length of the magnet is in contact with the inner ring.

Figure 6.26 – assembling magnet segments

6. Slide the magnet segment along the length of the inner ring until it touches the small stop at the front end of the inner ring.

7. Repeat steps 5 and 6 for the other magnet segments, making sure that each magnet is in opposite polarity with adjacent magnets.

Figure 6.27 – magnet in proper position

8. Align the new sleeve over the back of the rotor such that the sleeve indentations are lined up with the magnets.

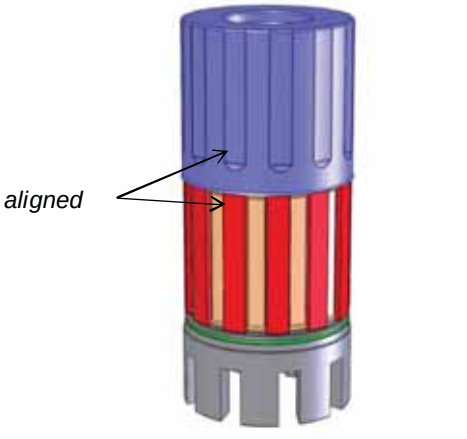


Figure 6.28 – proper sleeve alignment

9. Press the sleeve over the magnets and o-rings until it contacts the rear of the inner ring.

10. Visually inspect the front and rear of the sleeve to verify that the o-rings did not get damaged by the sleeve.

Figure 6.29 – assembled rotor

How To Install Rotor Assembly Into Outer Drive Assembly (Models S1-2 & S1-4)

1. Insert the canister [6] and support plate [7] into the outer drive assembly [100]. The support plate has no “top” or “bottom”, so it’s orientation doesn’t matter.
2. Use Tool F-00097 to firmly grab the rotor assembly [200] in the bushing bore area.
3. Bring the rotor assembly toward the canister until the back of the rotor is about 2 inches (5 cm) from the front of the outer drive assembly.

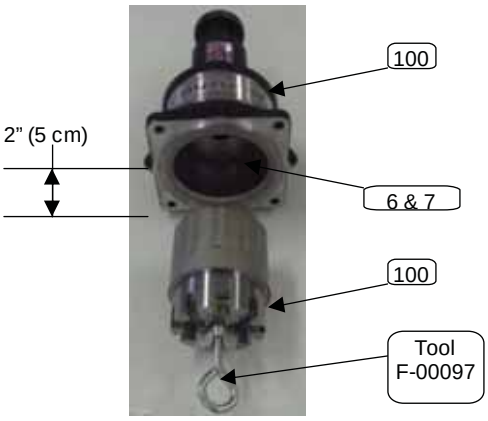


Figure 6.30 – tool in rotor assembly

4. Slowly let the outer magnets pull the rotor into the canister, while using moderate resisting force. The pulling force is about 40 – 60 pounds (18 – 27 kg).
5. Remove the puller tool.

Figure 6.31 – rotor assembly in place

How To Install Rotor Assembly Into Outer Drive Assembly (Models S1-24, S1-32, S1-55, S1-69 & S1-82)

1. Loosely fit the two rods into opposite holes on the outer drive assembly 100.
2. Loosely position the two rod ends into the channel.
3. Twist the two rods to tighten the channel nuts and clamp the rods to the channel.

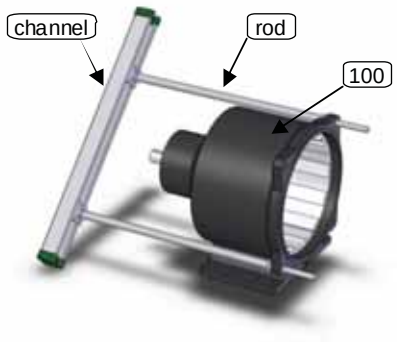


Figure 6.32 – rods and channel assembled

4. Assemble the two wing nuts onto the two rods to hold them to the outer drive assembly.
5. Carefully lift the outer drive assembly (with the tool kit attached) and set it on a suitable workbench vertically, with the rotor teeth facing up.
6. Firmly affix the channel to the workbench surface, so that it can safely resist a lifting force of up to 400 lbs (182 kg).

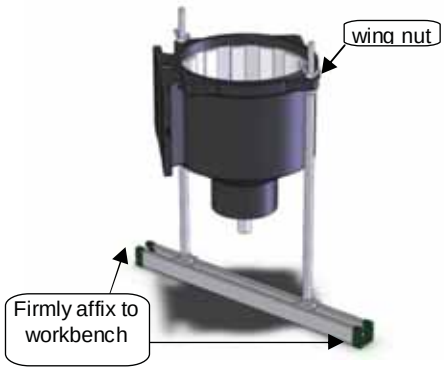


Figure 6.33 – outer drive assembly mounted to tool

7. Insert the canister 6 (containing the support plate 7) into the outer drive assembly. The support plate has no "top" or "bottom", so its orientation doesn't matter.

Figure 6.34 – insert canister and support plate

8. Attach the puller plate to the rotor assembly 200 using three of the pump's 1/2"-13 screws 9 or 10.

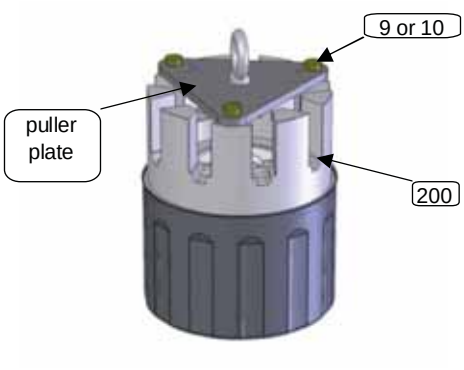


Figure 6.35 – puller plate on rotor assembly

9. Support the rotor assembly using a crane, hoist or other suitable lifting device, and position it above the canister, about 4 inches (10 mm) from the front of the outer drive assembly.

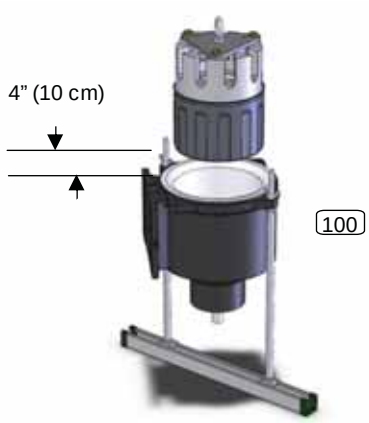


Figure 6.36 – rotor assembly ready for lowering

10. Slowly lower the rotor assembly into the canister.
    Note: During this process, the inner magnets on the rotor assembly will be strongly attracted to the outer magnets in the outer drive assembly.

Figure 6.37 – rotor assembly in place

11. Carefully lift the outer drive assembly (with the tool kit attached) and set it on a workbench, resting on the pump foot.

12. Remove the tool rods and puller plate.

Figure 6.38 – remove tool

How To Assemble Pumping Chamber

1. Make sure the casing orifice plug and casing block-off plug are in the correct locations:
   - Install the casing orifice plug (if required) [11] behind the DISCHARGE port.
   - Install the casing block-off plug [12] behind the SUCTION port.

2. Position the canister o-ring [4] in its groove in the casing [2]. If necessary, use a small amount of light adhesive to keep the o-ring properly positioned.

3. Slide the casing over the rotor [200], the lip of the canister [6] and magnet housing [101]. It may take some wiggling of the casing to get the canister and magnet housing positioned within the casing's alignment counterbore.

4. If necessary, rotate the casing to get the ports in the preferred position.

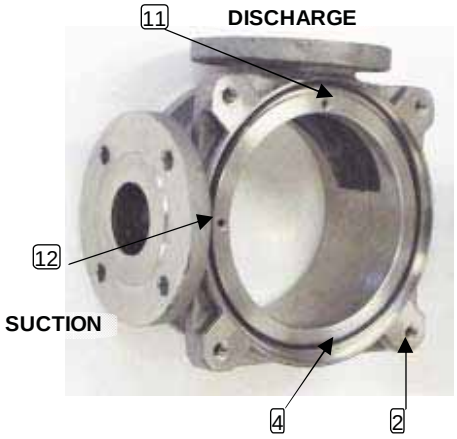


Figure 6.39 – casing plugs and o-ring

5. Insert the screws [10] that hold the outer drive assembly [100] to the casing.
   a. First, torque them to 5-10 ft-lbs (7-14 N-m) in an alternating pattern.
   b. Next, torque them to 20 ft-lbs (27 N-m) in an alternating pattern.
   c. Finally, torque them to their final values in an alternating pattern:
      - 3/8" screws: 40 ft-lbs (54 N-m).
      - 1/2" screws: 65 ft-lbs (88 N-m).

6. If the pump is not equipped with a relief valve, make sure the head block-off plug 14 is in the correct location, on the DISCHARGE side of the head.

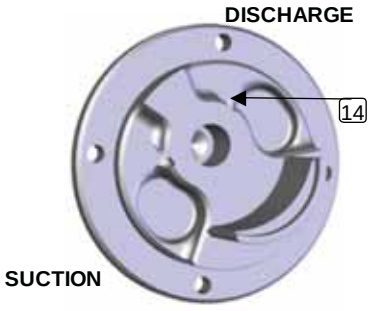


Figure 6.40 – head block-off plug

7. Slide the head o-ring 5 onto the head 1. Take care to avoid scratching the o-ring.

8. Position the head with the crescent facing up, and set idler assembly 300 and spindle 3 in place.

Figure 6.41 – head o-ring

9. Carefully insert the head/idler/spindle unit into the rotor. Take care to avoid cracking or chipping the carbon bushings.

10. Rotate the head so that the rotor and idler mesh between the ports.

11. Insert the screws 9 that hold the head to the casing, and torque them to their final values:
    - 3/8” screws: 40 ft-lbs (54 N-m).
    - 1/2" screws: 65 ft-lbs (88 N-m).

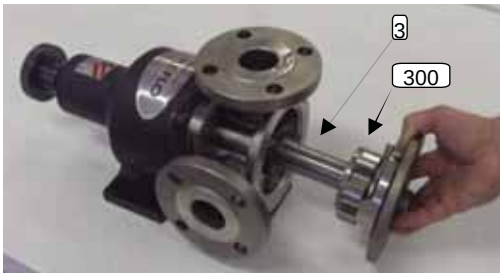


Figure 6.42 – insert head/idler/spindle

How To Assemble Relief Valve

1. Check the valve body o-ring 404 for damage, and replace it if necessary.

2. Position the valve body o-ring in its groove in the valve body 401. If necessary, use a small amount of light adhesive to keep the o-ring properly positioned.

3. Position the spring 403 and poppet inside the valve body.

4. Determine which pocket in the head 1 is aligned with the discharge port. The relief valve poppet 402 must be positioned on the discharge pocket for the valve to function correctly.

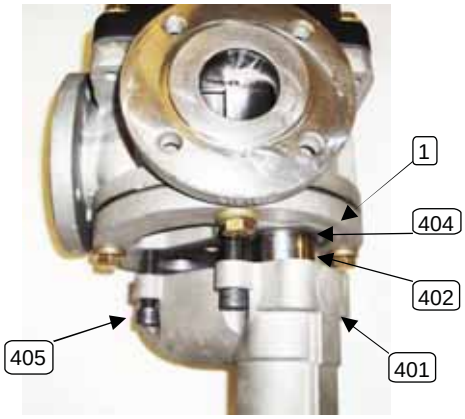


Figure 6.43 –relief valve assembly

5. Position the valve body/spring/poppet onto the pump head, with the poppet over the discharge pocket, and loosely assemble the valve body screws.

6. Tighten the screws in an alternating pattern until the valve body is fully contacting the head. Torque the screws to to their final values:
   - 3/8” screws: 40 ft-lbs (54 N-m).
   - 1/2" screws: 65 ft-lbs (88 N-m).

Symptom or Problem: Pump is excessively noisy.
Possible Cause(s):
- Air in the inlet fluid stream.
- Relief valve is opening.
- Pump has decoupled.
- Pump components are damaged or worn.
- Pump is cavitating.
- Discharge line is too restrictive.
- Cooling path is plugged.
- Ball bearings are worn or damaged.

Symptom or Problem: Pump does not prime.
Possible Cause(s):
- Discharge line is too restrictive.
- Suction lift is too great.
- Pump is not wetted.
- Air leak in the suction line.
- Pump is running in the wrong direction.
- Head is positioned incorrectly.
- Cooling path plugs are not installled.
- Pump is locked up with hardened fluid or foreign items.
- Pump components are damaged or worn.
- Pump has decoupled.
- Inner magnets have weakened.
- Cooling path is plugged.
- Relief valve is stuck open.

Symptom or Problem: Flowrate is too low.
Possible Cause(s):
- Head is positioned incorrectly.
- Cooling path plugs are not installled.
- Discharge line is too restrictive.
- Viscosity is lower than expected.
- Air in the inlet fluid stream.
- Pump is cavitating.
- Relief valve is opening.
- Pump components are damaged or worn.
- Bypass or auxiliary line in the discharge piping is open.
- Cooling path is plugged.
- Relief valve is stuck open.

Symptom or Problem: Pump does not develop enough pressure.
Possible Cause(s):
- Air in the inlet fluid stream.
- Viscosity is lower than expected.
- Pump is cavitating.
- Relief valve is opening.
- Pump components are damaged or worn.
- Bypass or auxiliary line in the discharge piping is open.
- Head is positioned incorrectly.
- Cooling path plugs are not installled.
- Cooling path is plugged.
- Relief valve is stuck open.

Symptom or Problem: Relief valve does not open.
Possible Cause(s):
- Pump is running in the wrong direction.
- Relief valve is stuck closed.

Symptom or Problem: Leakage from head/casing area.
Possible Cause(s):
- O-ring material is not compatable with the pumped fluid.
- Sealing surfaces for the o-rings are damaged.
- Bolt(s) are loose or missing.
- O-ring is damaged or missing.

Symptom or Problem: Leakage from casing/magnet housing area.
Possible Cause(s):
- O-ring material is not compatable with the pumped fluid.
- Sealing surfaces for the o-rings are damaged.
- Casing or magnet housing mounting flanges are cracked.
- Bolt(s) are loose or missing.
- O-ring is damaged or missing.

Symptom or Problem: Leakage from head/valve body area.
Possible Cause(s):
- O-ring material is not compatable with the pumped fluid.
- Sealing surfaces for the o-rings are damaged.
- Bolt(s) are loose or missing.
- O-ring is damaged or missing.

Symptom or Problem: Leakage from drive shaft area.
Possible Cause(s):
- Canister is damaged and leaking.

Symptom or Problem: Excessive vibration.
Possible Cause(s):
- Air in the inlet fluid stream.
- Relief valve is opening.
- Pump has decoupled.
- Pump components are damaged or worn.
- Pump is cavitating.
- Ball bearings are worn or damaged.
- Inner magnets have weakened.
- Cooling path is plugged.

Symptom or Problem: Pump draws too much power.

Possible Cause(s):

- Pump components are damaged or worn.
- Relief valve is stuck closed.
- Ball bearings are worn or damaged.
- Viscosity is higher than expected.

HOW TO RETURN PUMP TO FACTORY

If a pump must be returned to the EnviroGear factory, a Return Goods Authorization (RGA) must be obtained from EnviroGear or its authorized distributor. No RGA can be issued without a review of the appropriate Material Safety Data Sheets (MSDS). Pumps must be cleaned of all fluids and the ports plugged to prevent foreign material from getting into the pump.

EnviroGear warrants that on the day of delivery, all products manufactured by it shall be free from defects in materials and workmanship. For a period twenty four (24) months from the date of shipment EnviroGear will, at its sole and exclusive discretion, either replace or repair any products found by EnviroGear to be defective in workmanship or material, at no charge to the Purchaser.

The warranty does not apply to:

- any products which have been modified or altered by persons other than EnviroGear; or
- any products subjected to any misuse, neglect, misapplication, improper installation or accidental damage; or
- any goods manufactured by a third party; or
- any products damaged by the effects of abrasion, erosion or corrosion.

No returns will be accepted by EnviroGear unless accompanied by EnviroGear's written authorization and EnviroGear will assume no field expense for service or parts unless authorized in writing by EnviroGear in advance. All warranty replacement or repairs must be performed by EnviroGear or a EnviroGear Authorized Service Organization.

EnviroGear assumes no liability for consequential damages of any kind and the purchaser, by acceptance of delivery, assumes all liability for the consequences of the use or misuse of EnviroGear products by the purchaser, the purchaser's employees or others.

This warranty is exclusively for the benefit of the first purchaser of the product, other than a purchaser for resale, and cannot be transferred or assigned.

THERE SHALL BE NO OTHER WARRANTY, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER OBLIGATION ON THE PART OF ENVIROGEAR WITH RESPECT TO PRODUCTS EXCEPT THE WARRANTY OR WARRANTIES CONTAINED HEREIN.

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